CLAIMS

What is claimed is:

1. A hydraulic drive system comprising:

a hydraulic pump;

a hydraulic motor;

at least two hydraulic lines connecting the hydraulic pump to the hydraulic motor; and

a valve block having at least one connection to at least one of the hydraulic lines.

2. The hydraulic drive system of Claim 1, wherein the valve block comprises at least one valve mounted therein for reducing the pressure rise rate in the at least one of the hydraulic lines.

3. The hydraulic drive system of Claim 1, wherein the valve block forms a portion of the hydraulic lines connecting the hydraulic pump to the hydraulic motor.

4. The hydraulic drive system of Claim 1, wherein the valve block is connected to the at least one hydraulic line by means of a tee fitting.

5. The hydraulic drive system of Claim 1, wherein the valve block provides a fluid flow path between a pair of the hydraulic lines.

6. The hydraulic drive system of Claim 1, wherein the valve block provides a fluid flow path between at least one hydraulic line and an inlet to the hydraulic pump.

7. The hydraulic drive system of Claim 1, wherein the valve block provides a fluid flow path between at least one hydraulic line and a separate fluid sump.

8. A hydraulic drive system for use in a vehicle having a prime mover, the drive system comprising:

a first hydraulic pump driven by the prime mover and a first hydraulic motor;

a first set of at least two hydraulic lines connecting the first hydraulic pump to the first hydraulic motor;

a first valve block having at least one connection to at least one of the first set of hydraulic lines, the first valve block having a first valve mounted therein for reducing the pressure rise rate in at least one of the first set of hydraulic lines;

a second hydraulic pump driven by the prime mover and a second hydraulic motor;

a second set of at least two hydraulic lines connecting the second hydraulic pump to the second hydraulic motor; and

a second valve block having at least one connection to the at least one of the second set of hydraulic lines, the second valve block having a second valve mounted therein for reducing the pressure rise rate in at least one of the second set of hydraulic lines.

9. The hydraulic drive system of Claim 8, wherein the first valve block comprises a third valve mounted therein for reducing the pressure rise rate in the other of the first set of hydraulic lines, and the second valve block comprises a fourth valve mounted therein for reducing the pressure rise rate in the other of the second set of hydraulic lines.

10. The hydraulic drive system of Claim 8, wherein the vehicle comprises a zero turn vehicle.

11. The hydraulic drive system of Claim 10, wherein the zero turn vehicle comprises a mowing machine.

12. A valve block for use in connection with a hydraulic pump and a hydraulic motor, comprising:

a first port formed in the valve block and having a first opening and a second opening;

a second port formed in the valve block and having a third opening and a fourth opening;

a third port formed in the valve block and having a fifth opening, wherein the third port intersects both the first and second ports;

a first valve mounted in the first opening of the valve block and connecting the first port to the third port;

a second valve mounted in the third opening of the valve block and connecting the second port to the third port;

a first hydraulic line connected between the hydraulic pump and the hydraulic motor and comprising a first connection member between the first hydraulic line and the second opening of the first port;

a second hydraulic line connected between the hydraulic pump and the hydraulic motor and comprising a second connection member between the second hydraulic line and the fourth opening of the second port; and

a third return hydraulic line extending from the fifth opening of the valve block.

13. A valve block as set forth in Claim 12, wherein the first and second ports are parallel.

14. A valve block as set forth in Claim 13, wherein the third port is perpendicular to both the first and second ports.

15. The hydraulic drive system of Claim 12, wherein the third hydraulic line connects the valve block to an inlet to the hydraulic pump.

16. The hydraulic drive system of Claim 12, wherein the third hydraulic line connects the valve block to a separate fluid sump.

17. A hydraulic drive apparatus for use in a vehicle, comprising:

a first hydraulic pump mounted on the vehicle and a first hydraulic motor mounted on the vehicle, wherein the first hydraulic motor is connected to the first hydraulic pump by means of first and second hydraulic lines;

a first valve block mounted on the vehicle at a distance from both the first hydraulic pump and the first hydraulic motor, the first valve block comprising a first port connected to the first hydraulic line by means of a first connection member, a second port connected to the second hydraulic line by means of a second connection member and a third port having a third hydraulic line extending therefrom, wherein the third port intersects both the first and second ports;

a first valve mounted in the valve block and connecting the first port to the third port; and

a second valve mounted in the valve block and connecting the second port to the third port.

18. A hydraulic drive apparatus as set forth in Claim 17, wherein the third hydraulic line is connected to an inlet of the first hydraulic pump.

19. A hydraulic drive apparatus as set forth in Claim 17, wherein the third hydraulic line is connected to a separate fluid sump.

20. A hydraulic drive apparatus as set forth in Claim 17, further comprising:

a second hydraulic pump mounted on the vehicle and a second hydraulic motor mounted on the vehicle, wherein the second hydraulic motor is connected to the second hydraulic pump by means of third and fourth hydraulic lines;

a second valve block mounted on the vehicle at a distance from both the second hydraulic pump and the second hydraulic motor, the second valve block comprising a fourth port connected to the third hydraulic line by means of a third connection member, a fifth port connected to the fourth hydraulic line by means of a fourth connection member and a sixth port having a sixth hydraulic line extending therefrom, wherein the third port intersects both the first and second ports;

a third valve mounted in the valve block and connecting the fourth port to the sixth port; and

a fourth valve mounted in the valve block and connecting the fourth port to the sixth port.

21. A hydraulic drive apparatus as set forth in Claim 20, wherein the sixth hydraulic line is connected to an inlet of the second hydraulic pump.

22. A hydraulic drive apparatus as set forth in Claim 20, wherein the sixth hydraulic line is connected to a separate fluid sump.

23. A hydraulic drive apparatus comprising:

a hydraulic pump and a hydraulic motor;

a valve block comprising:

a first port passage extending through the valve block and having a first opening and a second opening, and a second port passage extending through the valve block and having a third opening and a fourth opening;

a first valve port formed in the valve block and having a fifth opening and a second valve port formed in the valve block and having a sixth opening, wherein the first and second valve ports are each hydraulically connected to both the first and second port passages;

a first valve mounted in the fifth opening of the valve block for controlling the connection between the first and second port passages and a second valve mounted in the sixth opening of the valve block for controlling the connection between the first and second port passages;

a first set of hydraulic lines connected between the hydraulic pump and the first and third openings in the valve block; and

a second set of hydraulic lines connected between the hydraulic motor and the second and fourth openings in the valve block.

24. The hydraulic drive apparatus of Claim 23, wherein the first and second port passages are not in the same plane.

25. The hydraulic drive apparatus of Claim 23, wherein the first valve is responsive to the pressure rise rate in the hydraulic line connected between the hydraulic pump and the first opening in the valve block and the second valve is responsive to the pressure rise rate in the hydraulic line connected between the hydraulic pump and the third opening in the valve block.

26. A valve block for use in connection with transferring hydraulic fluid between a hydraulic pump and a hydraulic motor, comprising:

a first set of openings formed in one side of the valve block for hydraulically connecting the valve block to the hydraulic pump;

a second set of openings formed in a second side of the valve block for hydraulically connecting the valve block to the hydraulic motor;

a first port passage formed in the valve block and connecting one of the first set of openings to one of the second set of openings;

a second port passage formed in the valve block and connecting the other of the first set of openings to the other of the second set of openings;

first and valve ports formed in the valve block, wherein the first and second valve ports are each hydraulically connected to both the first and second port passages;

a first valve mounted in the first valve port, wherein the first valve is closed during normal operation and opens when the pressure in the first port passage reaches a selected level to permit hydraulic fluid to bypass from the first port passage to the second port passage; and

a second valve mounted in the second valve port, wherein the second valve is closed during normal operation and opens when the pressure in the second port passage reaches a selected level to permit hydraulic fluid to bypass from the second port passage to the first port passage.

27. A valve block as set forth in Claim 26, wherein the first and second port passages are parallel to one another.

28. A valve block as set forth in Claim 27, wherein the first and second valve ports are parallel to one another and perpendicular to the first and second port passages.

29. A vehicle comprising:

a hydraulic pump and a hydraulic motor mounted on the vehicle; and

a valve block mounted on the vehicle separate from the hydraulic pump and hydraulic motor, the valve block comprising:

a first set of openings formed in one side of the valve block for hydraulically connecting the valve block to the hydraulic pump and a second set of openings formed in a second side of the valve block for hydraulically connecting the valve block to the hydraulic motor;

a first port passage formed in the valve block and connecting one of the first set of openings to one of the second set of openings;

a second port passage formed in the valve block and connecting the other of the first set of openings to the other of the second set of openings;

first and valve ports formed in the valve block, wherein the first and second valve ports are each hydraulically connected to both the first and second port passages; and

first and second valves each mounted in one of the valve ports, wherein both valves are closed during normal operation of the hydraulic pump and motor, and wherein the first valve opens when the pressure in the first port passage reaches a selected level to permit hydraulic fluid to bypass from the first port passage to the second port passage and the second valve opens when the pressure in the second port passage reaches a selected level to permit hydraulic fluid to bypass from the second port passage to the first port passage.

30. The vehicle of Claim 29, wherein the first and second valve ports are parallel to one another and perpendicular to the first and second port passages.